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4 October 1965

Westinghouse Electric Corporation

Air Arm Division
Friendship International Airport
Box 746, Baltimore 3, Md.
Telephone: 761-1000

September 22, 1965

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Advanced Plans & Programs Office (ASZ-5)
Deputy for Systems Management
Hq., Aeronautical Systems Division
Wright-Patterson Air Force Base, Ohio

Subject: Contract AF33(600)40280
Westinghouse Reference: DYD-45196

Enclosure: (1) Three (3) copies Progress Report August 1 - August 31, 1965, dated September 22, 1965

Gentlemen:

In accordance with the subject contract, we are enclosing the progress report for the period indicated.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

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PROGRESS REPORT

PERIOD OF 1 AUGUST 1965 TO 31 AUGUST 1965

CONTRACT NUMBER AF33(600)40280

SEP 22 1965

BY

WESTINGHOUSE ELECTRIC CORPORATION

AEROSPACE DIVISION

P. O. Box 746, Baltimore, Maryland 21203

SPECIAL HANDLING

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A F-101 FLIGHT TEST

FLIGHT TESTS

Six radar flights were flown in August, five of which produced useful data. Three of these missions were flown over Baltimore Harbor to obtain target signature data on a merchant ship. Specific information on all six flights is tabulated in Appendix A.

Aircraft rework performed by an Air Force team from Hill AFB, Utah, was completed and an aircraft functional check flight flown on August 3. This rework satisfies the current repair requirements in lieu of IRAN.

An overboost on the right hand engine in after-burner operation above 30,000 feet altitude has prevented super-sonic flights for almost five months. After many unsuccessful parts replacements and tests, the right engine was replaced this month. The functional check flight on August 18 showed satisfactory after-burner operation.

A Tech Order concerning inspection of after-burner sections of all F-101 engines was received and complied with after the engine change.

TABLE I

F-101 PROGRAM SUMMARY

August 1965

Flights Scheduled			12
Flights Accomplished			8
Aircraft Functional Test Flights		2	
Radar		6	
Productive Flights		1	
Productive Flights Prior to a Failure		4	
Antenna Pressure Failure	1		
Transmitter and Transmitter Servo	3		
No Results		1	
Recorder Film Drive	1		
Flights Cancelled			4
Antenna Pressure Failure		1	
Transmitter and Transmitter Servo		2	
Weather		1	

MODIFICATIONS AND GROUND TESTS

Transmitter and Transmitter Servo

Servo lock-up problems were encountered with transmitter 001. Both the original set of servo printed circuit boards and the replacement set were defective. Satisfactory operation was obtained with the third set of boards; filtering was added to improve performance. The two defective sets are being repaired.

Receiver and Frequency Generator

Video noise level decreased during the course of flight 182. An intermittently open inductor in the Frequency Generator caused a 3 db decrease in the video local oscillator voltage. In addition, a defective transistor was found in the Frequency Generator circuit for the DFT local oscillator. This undoubtedly caused the loose DFT control of the past few flights and will be checked further on the next flight.

Recorder

After the modification to the electronic package, recorder 007 was installed in the F-101 prior to flight 181. Operation with type 2401 film (mylar, 4 mil thick base) was satisfactory. Since the supply of type 2401 film was exhausted, type 5401 (acetate, 512 mil thick base) was substituted. Normal film transport could not be obtained. Recorder 005 worked properly with type 5401 and was reinstalled on the aircraft to minimize system down-time. Recorder 007 was returned to the lab for repair.

Antenna

An antenna pressure failure on flight 177 caused a pressure window burn-out. The antenna was repaired by replacing two modules and sealing leaks in the manifold.

Linear Motion Compensation

Ground tests indicated good Linear Motion Compensation system operation. Network null voltage, resonant time, and transient response were all satisfactory.

A new flight procedure for the Linear Motion Compensation was used on flight 182. This procedure was:

1. start erection of roll table
2. 5 seconds later, connect accelerometer integrating network to VFO
3. 5 seconds later, switch roll table to Reset, which refines the roll table position with the accelerometer mounted on the table
4. 20 seconds later, unground the integrator input and switch network gain from low to high
5. 25 seconds later, with a total elapsed time of 55 seconds, roll table is returned from Reset to Normal, which connects accelerometer to the network.

The radar operator was satisfied with the operation, but film and instrumentation data have not been analyzed.

KA-45-A Camera

After repair and adjustment of the KA-45A camera at the manufacturer, the camera was re-installed in the aircraft. Initial ground checks were acceptable. However, on flight 178 the film transport jammed. Operation was satisfactory on 179 but a jam occurred again on flight 180. Cause of the failures is being investigated.

B FIELD FLIGHT TEST

Understanding that the SOARD radar may be tested in the western area this fall, a proposal is being prepared for the reactivation of the Field Flight Test. First flight is tentatively set for 1 November 1965.

C SYSTEM

Two technical memorandums were recently released. STM-170 titled "Pulse Narrowing Investigation" summarizes the narrow pulse work on the transmitter, including the effect on overall system resolution. "Effect of Temperature and Humidity on Aerial Films", STM-171, reviews the general environmental effects on aerial films as they are used in the SOARD recorder.

RECORDER

Modifications to the second electronic package are now complete. Work on the last package is well underway and, when complete, will allow full interchange of recorders or their sub-assemblies.

AUTOMATIC GAIN CONTROL

Receiver gain has sometimes varied between the pre-flight checks and the mapping runs, because of changes in voltage, temperature, or component tube gains. The recorded signal level has a significant effect on the quality of map, causing changes in target signatures. Automatic gain control (AGC) has been proposed as a minor modification to the F-101 system to provide more uniform gain.

Noise is used as an indicator of receiver gain, as shown in the block diagram of Figure 1. The noise is gated during the no-signal period between the time of the transmitted pulse and the

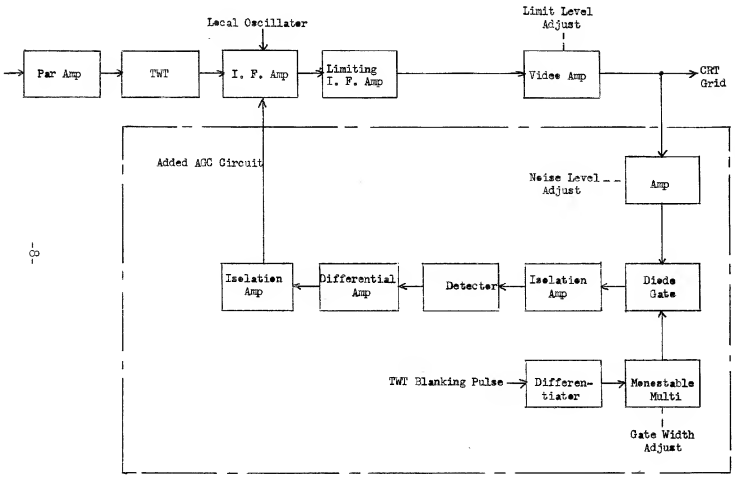

FIGURE 1

PROPOSED AGC BLOCK DIAGRAM

altitude line. The gate width is adjustable to accomodate various altitudes, with 30 microseconds being sufficient for 20,000 and 40,000 feet. When the "second-time-around-return" is used on the Field Flight Test (4 kc recorder operation), the AGC as mechanized is not usable.

The gated noise is detected and sensed by a differential amplifier. The differential output is isolated with a common emitter amplifier, which matches the impedance to the grid circuit of the I.F. amplifier. The differential amplifier tends to maintain its input at a fixed 3 volt level by adjusting the I.F. gain. The output noise level of the Video Amplifier is set by adjusting the gain of the first amplifier in the AGC loop.

The proposed AGC scheme has proved to be feasible in a laboratory set-up. Work is underway to adapt this circuit to a flyable breadboard for the F-101. After test flights with the AGC, its performance will be evaluated to determine if additional units are desired for the deliverable systems. Little modification is required to incorporate the AGC in the present system. The R.F. failure connector on the Video Amplifier can be used to provide the input signal with no additional loading on the CRT grid. A connector on the I.F. amplifier is already available for the gain control.

ANTENNA

Study of the bonding problem at Westinghouse Research Labs is complete, except for the writing of a report on their investigations.

DuPont Polyimide High temperature binder solutions have been evaluated. Type PI-1101 failed to hold air at room temperature. PI-1200 produced a good bond, but no additional tests are planned since this material is similar to the I40 resin already tested and the recommended cure temperature exceeds available oven temperatures.

Tests showed no significant advantage of cleaning with Freon as compared to Trichloroethylene now used. No chemical action or deterioration of bond was noted with either material after a 30 hour soak at 550°F.

The most significant result was that sticks on which mylar tape was not used to mask the slots had no areas of poor adhesion. It is felt that the adhesive on the mylar tape previously used has caused the spots of poor adhesion. With this problem corrected with a change in tape, repair of the antennas can continue.

Using the resin and fabric from the same batches as will be used for the final units, eight sticks were bonded in accordance with the latest revision to the process specification. All eight sticks held air at room temperature. Three of the sticks are being tested at 550°F and 30 psig pressure. By the end of August, the three were holding pressure after 100 hours testing.

The array sticks are presently joined to the manifold with a 95% lead-5% indium solder as a pressure seal covered with an electroformed wall for mechanical strength. There is a low margin between the chart value melting point of the solder (314°) and the maximum use temperature of 288°C. Excess solder and flux flow into the

interior of the manifold and must be removed by blind etching, which often requires resoldering. Higher temperature solders are no improvement. A high temperature local heating method, such as electron beam welding, may be more desirable. This process would perform the functions of the solder, etching, and electroforming. Disassembly and repair would be more difficult. Additional investigation is underway to select the best procedure.

D SPARES

No items were added to either the system or ground support equipment spares. Status of spares is summarized:

	Items Shipped in August	Items Open	Per Cent Complete
System	1	13	99
Basic list plus first 10 amendments	0	8	99
Amendment 11 (remains open)	1	5	--
Ground Support Equipment	0	1	99

Six of the remaining items on the basic system list are antenna array modules held for rework with the new bonding process.

E CORRELATOR OPERATION

Flight 182 was correlated on August 31, the first high altitude flight since April. Data was good, but the near range was very light. It appears that alignment was incorrect on the .050 inch upper slit recently added. A test will be made with various positions of the slit.

An Omega D6 Englarger has been received and installed in the darkroom with the Log-E-Tronic dodging printer. Various films were tested with the dodging printer. Type 8430, an aerial duplicating film, was too slow and had insufficient dynamic range. Although 5427 has better dynamic range than 8430, it is still slow. Kodalith Ortho Type 3 proved to lack the tonal qualities needed. Panatomic X was found to be the best, with sufficient speed and resolution.

The Panatomic X is developed by hand in DK50 diluted 1 to 1. Resolution and grain structure are fine enough using DK 50. Contrast is higher and development times shorter than for a fine grain developer such as Microdol-X.

Best exposure for an intermediate positive appears to be one stop greater than for a normal print at maximum dodging. This intermediate positive is then dodged to make a negative for final paper prints.

The diverger for the laser was received for the Detail Correlator. Since the laser was not centered with respect to the diverger mount, the beam was driven off at about a 10^{o} angle. It was then decided to use the microscope objective in conjunction with the pin-hole from the diverger. This provided a cone with few of the dark rings inherent with a larger pinhole.

The spare optics for the dynamic Correlator just received from Itek were then set up in the Detail Correlator. A six inch enlarging lens is used to bring the output azimuth image to the same separation as on the input film. The aspect ratio is very close to 1 to 1.

F CORRELATOR MECHANICAL REVIEW

Rough draft of the report on the correlator design investigation is complete and now being reviewed. The resulting memorandum will be the basis for a proposal, soon to be submitted.

SUMMARY OF FLIGHTS - APPENDIX A			
FLIGHT NO.	177	178	179
DATE	8-4-65	8-10-65	8-12-65
ALTITUDE	20,000	20,000	20,000
AREA	Baltimore, Maryland	Philadelphia, Pa.	Baltimore, Maryland
PURPOSES	Target signature of merchant ship	Comparison of resolution of tank farm with perpendicular courses.	Target signature of merchant ship.
SIGNIFICANT SYSTEM CHANGES		Two antenna modules changed; HV tap for CFA moved; 40 watts average power.	
RESULTS	Slightly smeared during first 2 or 3 clocks. Transmitter out of coincidence for remainder of flight. Shore boundaries barely discernible.	Map is fair over best areas but not as good as 168,169 and 173. Bands of density variations of several second durations are mainly due to DFT loop tracking. Far range is more defocussed in azimuth than usual. Some FM striations exist.	Map best from 1/3 to 3/4 range. Resolution and contrast are good in best areas. Particularly at low level. Varying density bands still exist but targets are easily recognized. Some divergent clutter, except very low over Harbor in Run 3.

SUMMARY OF FLIGHTS

FLIGHT NO.	180	181	182
DATE	8-12-65	8-24-65	8-30-65
ALTITUDE	20,000	20,000	45,000
AREA	Baltimore, Maryland	Wallops Island and Friendship Airport	Philadelphia, Pa.
PURPOSES	Target signature of merchant ship	Data acquisition and DFT check	High altitude data acquisition and linear motion comp. system test.
SIGNIFICANT SYSTEM CHANGES		Breadboard transmitter and recorder 007 installed.	Modified LMC integrator & recorder 005 installed.
RESULTS	Map best from 1/3 to 3/4 range. As in 178 and 179 antenna coverage is good. Map quality similar to that of 179. An unusual range clutterlike smear is present on only one ship at clock 4-9. Sparrows Point detail good in Run 2.	No data. Film speed approximately 1.5 times greater than desired because of Recorder failure.	Far range strip is good in contrast & azimuth resolution. Range resolution is degraded. Density variation still present due mostly to DFT tracking. Near range strip faded out over near half of its range. Antenna position is moved about due to accelerometer network output. This can be partly attributed to roll table error.